Center Innovation Fund: JSC CIF

Advanced Multifunctional MMOD Shielding

Completed Technology Project (2010 - 2013)

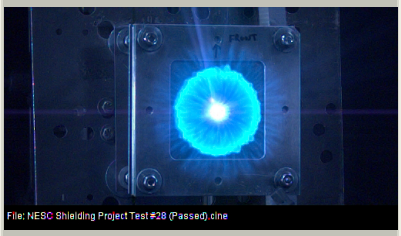
Project Introduction

This project is developing micrometeoroid and orbital debris (MMOD) shields which incorporate thermal protection, radiation protection, damage detection & location sensors and self-healing properties. We are developing and demonstrating in hypervelocity impact tests: (1) MMOD toughened, smart thermal blankets, (2) combined MMOD/radiation protection shields, (3) shields incorporating self-sealing materials. Current state of the art MMOD shielding is single functional. Multifunctional MMOD shielding technology will reduce future spacecraft mass, and improve crew safety and mission success.

MMOD toughened, smart thermal blankets. The project was successful over the past two years in developing and demonstrating by test (hypervelocity impact and thermal vacuum tests) an MMOD toughened, smart thermal blanket concept that is adaptable to different levels of MMOD threat and/or reliability levels. This blanket includes integrated impact sensor technology to determine the location and extent of MMOD impact damage. Combined MMOD/radiation protection shields. The project also has made considerable progress in developing improved MMOD and radiation shields that have so far shown better MMOD performance than the best ISS MMOD shields, while decreasing radiation dosage by 30% from solar proton events (SPE). Self-sealing materials in MMOD protection. In FY13, impact tests on alternative shielding concepts will be performed that incorporate self-sealing materials able to close or reduce the size of holes in pressure shells. Tests to-date indicate that combinations of ionomer polymers and reinforcing materials are successful at closing 0.25" diameter holes in aluminum pressure shells under 0.3 atmosphere delta-pressure. Additional impact tests using these and other materials (thermoplastic and elastomeric polymers) are planned in FY13 for up to 1 atmosphere delta-pressure.

Anticipated Benefits

This project seeks to develop advanced, multifunctional MMOD shielding which results in mass savings compared to current MMOD shielding technology, and combines MMOD and radiation protection. Desired performance characteristics addressed by this project are developing: (1) lightweight MMOD shielding that reduces spacecraft shield mass by at least 20-25%, (2) multifunctional shielding combining MMOD, thermal and radiation protection, (3) capability to detect and locate MMOD impacts for particles larger than 0.1mm, (4) cost/mass efficient multi-use radiation shield systems. We provided data/information on the toughened thermal blankets to the NASA GSFC Observatory Manager for the upcoming MAVEN (Mars orbiter) mission, which could encounter increased impacts from cometary debris. The toughened thermal blanket technology developed in this project has also been shared with a project responsible for building an inflatable module for ISS, for possible application to protecting bulkheads and other areas of the inflatable module.



Project Image Advanced Multifunctional MMOD Shielding

Table of Contents

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

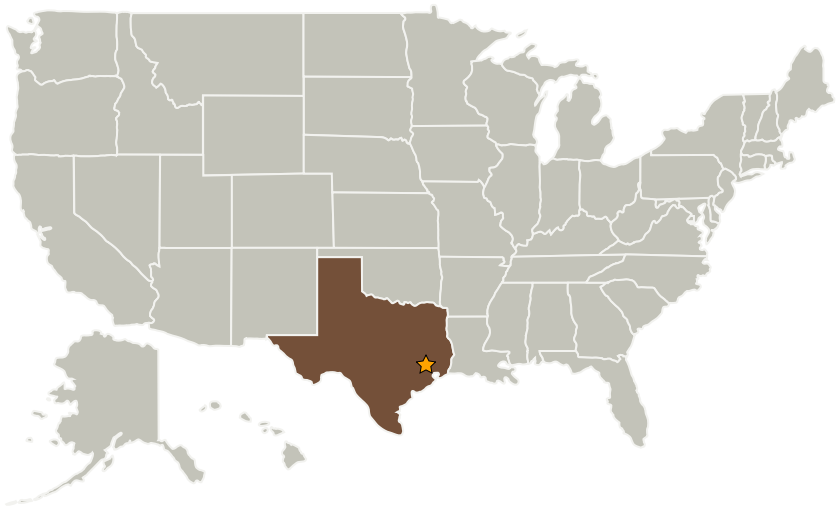
Center Innovation Fund: JSC CIF

Center Innovation Fund: JSC CIF

Advanced Multifunctional MMOD Shielding

Completed Technology Project (2010 - 2013)

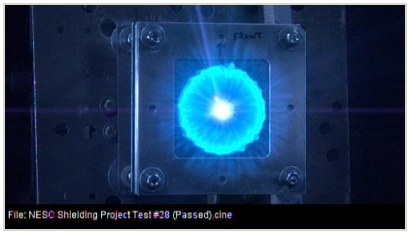
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations
Texas

Images



12106-1378238518746.jpg
Project Image Advanced Multifunctional MMOD Shielding
(https://techport.nasa.gov/image/2266)

Project Management

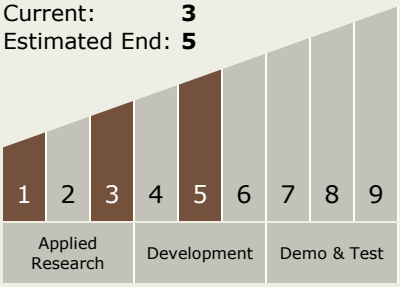
Program Director:
Michael R Lapointe

Program Manager:
Carlos H Westhelle

Project Manager:
Eric L Christiansen

Technology Maturity (TRL)

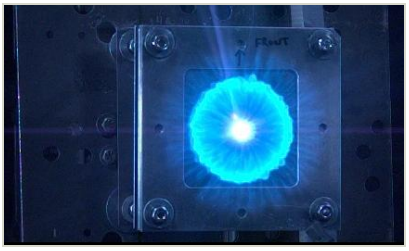
Start: **1**
Current: **3**
Estimated End: **5**



Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.5 Radiation
    - TX06.5.3 Protection Systems



12106-1378240554703.jpg
Project Image Advanced Multifunctional MMOD Shielding
(https://techport.nasa.gov/image/2267)